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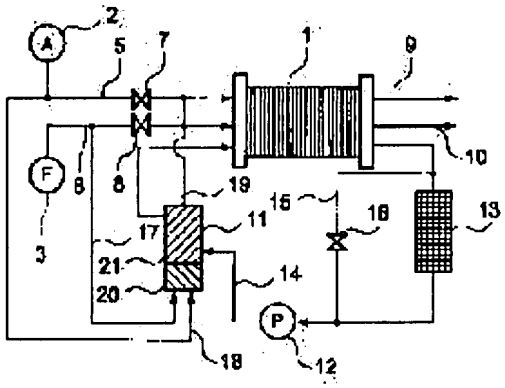
(54) POWER GENERATING SYSTEM FOR SOLID HIGH MOLECULAR FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To enable safe and efficient start in a short time with the simple structure even in a low peripheral temperature condition at 0°C or less.

SOLUTION: This system is provided with a solid high molecular fuel cell stack 1 formed by laminating plural single cells, which are respectively formed by holding a solid high molecular film between a fuel pole and an oxidant pole through a catalyst layer, through a separator having a groove for supplying the fuel gas and the oxidant gas to the fuel pole and the oxidant pole and a cooling plate, in which the antifreeze solution as a cooling medium passes. In this case, the system is also provided with an antifreeze solution heating means 11 provided on the way of the cooling system passage for flowing the antifreeze solution and for heating the antifreeze solution with the reacting gas while burning the fuel gas with the oxidant gas with a burner 20 and a burned waste gas supplying means 19 for supplying the burned waste gas to be discharged from the antifreeze solution heating means 11 to at least one of a fuel gas supplying route 5 and a oxidant gas supplying route 6 of the solid high molecular fuel cell stack 1.



LEGAL STATUS

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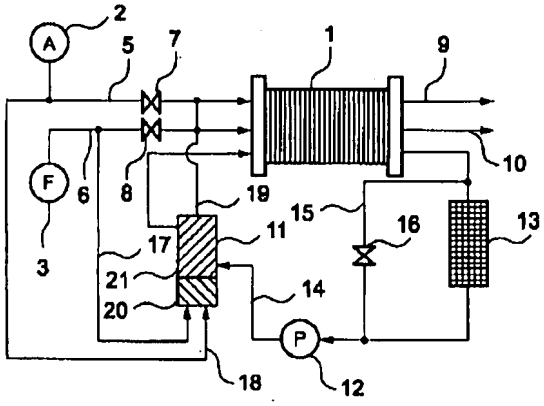
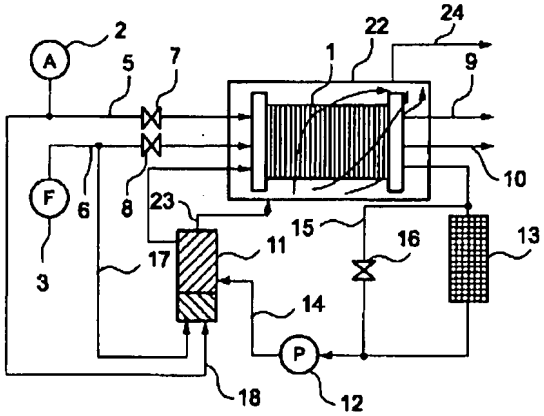
DRAWINGS

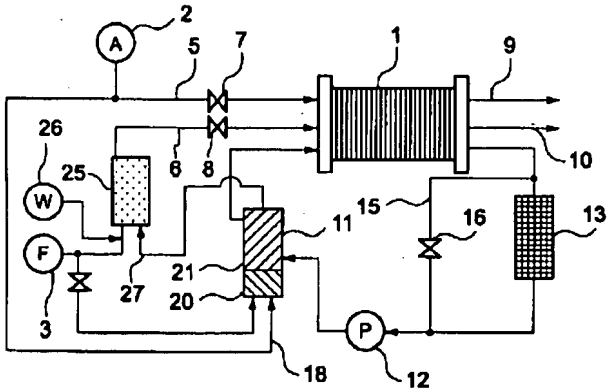
[Drawing 1]



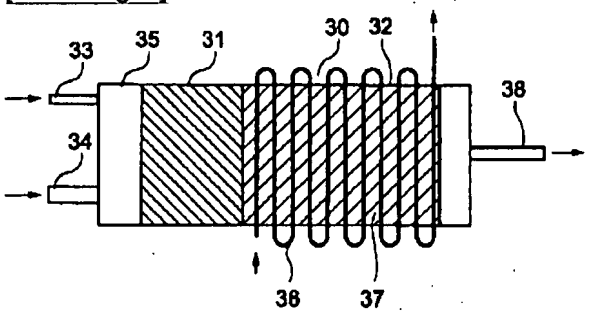
[Drawing 2]



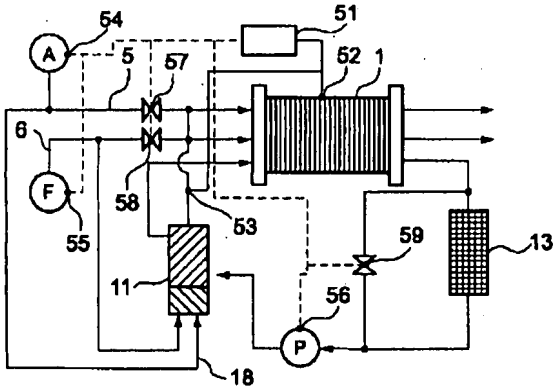
[Drawing 3]



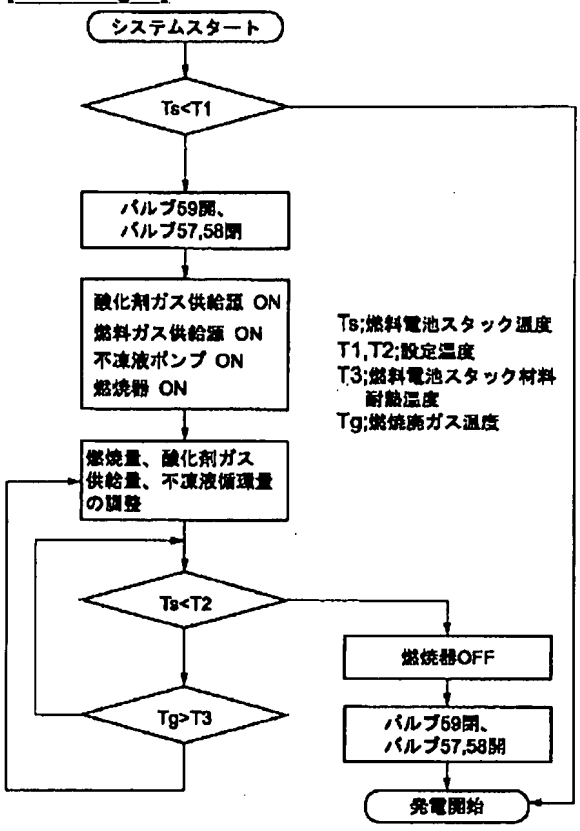
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Drawing 7]

said polymer electrolyte fuel cell stack The polymer electrolyte fuel cell power generation system which adds a control means to control the combustion amount of said antifreeze heating means, or the circulating load of said antifreeze, and is characterized by things.

[Claim 10] In said polymer electrolyte fuel cell power generation system according to claim 1 or 2 So that the temperature of the combustion waste gas detected by temperature detection means to detect the temperature of the combustion waste gas discharged from said antifreeze heating means, and said temperature detection means may not exceed a heat-resistant temperature of the component of said property modification machine The polymer electrolyte fuel cell power generation system which adds a control means to control the combustion amount of said antifreeze heating means, or the circulating load of said antifreeze, and is characterized by things.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the polymer electrolyte fuel cell power generation system which is built over the polymer electrolyte fuel cell power generation system constituted by having the polymer electrolyte fuel cell which used the solid polymer membrane as an electrolyte, especially enabled it to start the system at the time of the atmospheric temperature outside low for a short time.

[0002]

[Description of the Prior Art] Generally a fuel cell is equipment which transforms into direct electric energy the chemical energy which a fuel has by making oxidant gas, such as heating gas, such as hydrogen which is reactant gas, and air, react electrochemically. Although this fuel cell is classified into a thing various type according to the difference in an electrolyte etc., the polymer electrolyte fuel cell which used the solid polymer membrane for the electrolyte is known as one of them.

[0003] Drawing 8 is the sectional view showing the basic composition (single cell composition) of this kind of polymer electrolyte fuel cell.

[0004] The fuel electrode which has arranged the polymer electrolyte fuel cell in drawing 8 on both sides of the solid polymer membrane 102 which has ion conductivity 103 and the single cell 101 which consists of an oxidizing agent pole (a cathode electrode is called hereafter) 104, (An anode electrode is called hereafter) Slot 103 for supplying the heating gas and oxidant gas which are reactant gas to each electrode (c) 104 (c) It consists of fundamentally gas impermeability separators 105 with a gas supply slot which have the established conductivity.

[0005] In addition, the anode electrode 103 is formed from the anode catalyst bed 103 (a) and the anode porosity carbon plate 103 (b), and the cathode electrode 104 is formed, respectively from the cathode catalyst bed 104 (a) and the cathode porosity carbon plate 104 (b).

[0006] In the polymer electrolyte fuel cell of the above composition, if heating gas is supplied to the anode electrode 103 and oxidant gas is supplied to the cathode electrode 104, respectively, electromotive force will arise according to an electrochemical reaction in inter-electrode [of the single cell 101 / a pair of]. Here, air is used from hydrogen as heating gas, and is usually used as oxidant gas, respectively.

[0007] When hydrogen is supplied to the anode electrode 103 and air is supplied to the cathode electrode 104, respectively, [the anode electrode 103] The supplied hydrogen is dissociated into a hydrogen ion and an electron by the anode catalyst bed 103 (a), a hydrogen ion passes along the solid polymer membrane 102, and an electron passes along an external circuit and moves to the cathode electrode 104, respectively.

[0008] On the other hand, with the cathode electrode 104, oxygen, the above-mentioned hydrogen ion, and electron in the supplied air react by the cathode catalyst bed 104 (a), and generate water. At this time, the electron passing through an external circuit serves as electric current, and can supply electric power. That is, the respectively following reactions advance in the anode electrode 103 and the cathode electrode 104. In addition, the generated water is discharged out of a cell with unreacted gas.

[0009]

Anode reaction : H2 ->2H++2e- cathode reaction : 2H++1/2O2+2e--> less than 1V and since the electromotive force of the H2 O single cell 101 is low, it usually minds the above-mentioned separator 105 -- several 10- the single cell 101 of hundreds of sheets is laminated, and it is used as a fuel cell stack. Moreover, in order to control **** of the fuel cell stack accompanying power generation, the cold plate with which a cooling medium circulates is intercalated every single cell 101 of several sheets.

[0010] On the other hand as a solid polymer membrane 102 which has ion conductivity, the perfluoro ROKABON sulfonic acid (the U.S. and E. I. du Pont de Nemours Nafion R:& Co.) which is proton exchange membrane, for example is known.

[0011] The function to separate heating gas and oxidant gas also has this solid polymer membrane 102 while it has the exchange group of a hydrogen ion in a molecule and functions as an ion conductivity electrolyte by carrying out saturation water.

[0012] On the contrary, if the moisture content of the solid polymer membrane 102 decreases, ion resistance becomes high, mixing (crossover) with heating gas and oxidant gas will occur, and power generation by a cell will become impossible. For this reason, what the solid polymer membrane 102 is made into saturation water for is desirable.

[0013] When the hydrogen ion separated with the anode electrode 103 by power generation moves to the cathode electrode 104 through the solid polymer membrane 102 on the other hand, in order that water may also move together, in the anode electrode 103 side, the solid polymer membrane 102 becomes a desiccation tendency.

[0014] Moreover, if there are few steams contained in the air which is the heating gas or oxidant gas to supply, the solid polymer membrane 102 will become a desiccation tendency near [each] a reactant gas entrance.

[0015] Since it is above, generally supplying the heating gas humidified beforehand and oxidant gas is performed to the polymer electrolyte fuel cell.

[0016] By the way, although operated at a temperature of about 80 degrees C of operation, since atmospheric temperature may fall to the freezing point when used outdoors, as for such a polymer electrolyte fuel cell, the power supply for mount etc. usually needs to take the measures against freezing of the whole system at the time of a system stop, for example. Furthermore, it is necessary to shorten starting time until a system starts as much as possible.

[0017] In this case, the former, In The 14 th International ElectricVehicle Symposium and Exposition held in 1997 Ron I.Sims "Cold Weather Various methods have been proposed as stated to the paper announced in the title of Operational Considerations for Direct Hydrogen Automotive Fuel Cell System. as the typical thing -- (a) -- by making minute amount heating gas always react Start the compressor which supplies the air which is an oxidizing agent to (Method b) fuel cell stack which keeps a system warm so that it may not become below the freezing point, and [with hot compressed air] The method (d) heating gas which preheats a system by the method (c) electric heater preheated and started and the waste heat at the time of fuel cell stack operation is burned with a burner (burner), and the method of heating a fuel cell stack etc. is proposed by heating an antifreeze with the heat of reaction.

[0018] Starting is made possible for a short time by carrying a big burner in starting by the system of the above (d) from very low temperature, especially, although it is natural.

[0019] Moreover, the method of collecting on a tank the water used during system operation by gravity at the time of a system stop, and blowing away and collecting with air the water which remained in the fuel cell stack further in this paper, is also proposed.

[0020] On the other hand, the method currently indicated by "JP,H9-147892,A" is also the same view as this, gravity or reactant gas recovers the water which collected on the fuel cell stack at the time of a system stop to a water recovery tank, and the technology of preventing freezing of the water inside a system is also known.

[0021] Furthermore, he is trying to avoid the problem of freezing of water by making it not use water for humidification of reactant gas by the method currently indicated by "JP,H8-185877,A", for example.

[0022] That is, since it has the composition that the inside of fuel cell Stack is not covered with water as a liquid in order to humidify reactant gas refining and by dissociating using ultrafiltration membrane, the problem of freezing is lost and short-time starting of the water contained in an antifreeze is enabled.

[0023]

[Problem to be solved by the invention] However, there is a problem as shown below in the polymer electrolyte fuel cell which adopted the conventional method described above.

[0024] By the method to which minute amount above (a) heating gas is made to always react, since heating gas is always consumed even if it calls it a very small quantity quantity, it will lead to loss of energy. In a very-low-temperature area, especially this loss will become big. Moreover, it cannot be said to be a desirable thing from the field of safety, either.

[0025] Although the air which is oxidant gas is used as a heat carrier by the method of heating beforehand by the compressed air of the compressor of the above (b), air is a medium with small specific heat, and since it moreover becomes heating by sensible heat, its quantity of heat which can be carried is small, and it requires much time for the worm rise of a system. Moreover, in order to operate a compressor under electric power, a big battery is needed, and the whole system enlarges it, and it has the problem of becoming weight.

[0026] By the method of preheating a system by the electric heater of the above (c), and the waste heat at the time of fuel cell stack operation, while the problem that a big battery is needed arises like the above (b), by the time it becomes the conditions which can be generated, much time will be

needed.

[0027] [by the method of heating an antifreeze with the heat of combustion of the burner of the above (d), since the antifreeze which has big specific heat is made into a heat carrier, to be sure, can supply a lot of heat, and can shorten preheating time, but] Within a fuel cell stack, since the pass of a cooling medium will be heated first and the solid polymer membrane circumference will be heated by heat conduction in a fuel cell stack after that, there is surely a limit in shortening of warming up time. Moreover, since hot combustion waste gas will be thrown away into the exterior, it is connected also with the futility of energy.

[0028] Furthermore, although the inside of fuel cell Stack is covered with water, ** becomes there is not less and surely the problem of freezing is lost by the method which collects cooling water to a water tank, since the water in a tank is frozen, in advance of a start, it is necessary to thaw the water in a tank first. Moreover, since it becomes complicated [the control] while a pipeline becomes complicated, since it is necessary to collect water at the time of a system stop, more spaces are required and it becomes the factor of a cost rise.

[0029] On the other hand, in the system using the water refined from the antifreeze to humidification of reactant gas, since it is necessary to put a big pressure when a filtration film generally refines water from an antifreeze, a powerful pump and a heat-resistant container are needed, and it becomes the factor of enlargement of an instrument, and also a cost rise. And in order to always operate a pump during operation, decline in system efficiency will be caused. Moreover, as long as a filtration film is used, an impurity may be stuck for a film and there is a problem that a periodical maintenance is needed.

[0030] The purpose of this invention is to offer the polymer electrolyte fuel cell power generation system which can be started with structure safely efficient in a short time, and compact moreover, even if circumference environmental temperature becomes low temperature of 0 degree C or less.

[0031]

[Means for solving problem] In order to attain the above-mentioned purpose, it makes it come through a catalyst bed to pinch a solid polymer membrane among a pair of gas diffusion electrodes which consist of fuel electrodes and oxidizing agent poles. [the single cell which generates electricity by the electrochemical reaction of heating gas and oxidant gas, and generates an electric output] The gas impermeability separator which has a slot for supplying heating gas and oxidant gas to a fuel electrode and an oxidizing agent pole, And the polymer electrolyte fuel cell stack laminated through the cold plate with which the antifreeze which is a cooling medium circulates is set to the polymer electrolyte fuel cell power generation system constituted by having. [two or more] An antifreeze heating means for it to be prepared in invention of Claim 1 while being the cooling system way where an antifreeze circulates, to burn heating gas with oxidant gas with a burner, and to heat an antifreeze with the heat of reaction, It has a combustion waste gas supply means to supply the combustion waste gas discharged from an antifreeze heating means to either [at least] the heating gas supply course of a polymer electrolyte fuel cell stack, or an oxidant gas supply course.

[0032] Therefore, by establishing an antifreeze heating means to heat an antifreeze with a burner, in the middle of the cooling course of an antifreeze in the polymer electrolyte fuel cell power generation system of invention of Claim 1, the heated hot antifreeze is supplied to the inside of fuel cell Stack, and a low-temperature fuel cell stack is heating **********. By supplying waste gas of the burner of an

antifreeze heating means to either [at least] the heating gas supply course inside fuel cell Stack, or an oxidant gas supply course simultaneously Since hot combustion waste gas is led to the reactant gas supply course inside fuel cell Stack, direct heating of the solid polymer membrane of the main part of a cell can be carried out, and the preheating time to a system startup can be shortened sharply.

[0033] Moreover, an antifreeze heating means for it to be prepared in invention of Claim 2 while being the cooling system way where an antifreeze circulates, to burn heating gas with oxidant gas with a burner, and to heat an antifreeze with the heat of reaction, It has the combustion waste gas instrument of circulation formed so that the combustion waste gas discharged from an antifreeze heating means might be passed along with the circumference of a polymer electrolyte fuel cell stack.

[0034] Therefore, by establishing an antifreeze heating means to heat an antifreeze with a burner, in the middle of the cooling course of an antifreeze in the polymer electrolyte fuel cell power generation system of invention of Claim 2, the heated hot antifreeze is supplied to the inside of fuel cell Stack, and a low-temperature fuel cell stack is heating **********. By passing waste gas of the burner of an antifreeze heating means simultaneously along with the combustion gas waste gas instrument of circulation in which it was prepared by the circumference of a fuel cell stack, a fuel cell stack can be heated also from an outside and the preheating time to a system startup can be shortened sharply.

[0035] Furthermore, it makes it come through a catalyst bed to pinch a solid polymer membrane in invention of Claim 3 among a pair of gas diffusion electrodes which consist of fuel electrodes and oxidizing agent poles. [the single cell which generates electricity by the electrochemical reaction of heating gas and oxidant gas, and generates an electric output] The polymer electrolyte fuel cell stack laminated through the cold plate with which the antifreeze which is the separator and cooling medium of the gas impermeability which has a slot for supplying heating gas and oxidant gas to a fuel electrode and an oxidizing agent pole circulates, [two or more] In the polymer electrolyte fuel cell power generation system constituted by having the property modification machine which is made to carry out property modification of the fuel, and supplies heating gas to the fuel electrode of a polymer electrolyte fuel cell stack An antifreeze heating means for it to be prepared while being the cooling system way where an antifreeze circulates, to burn the fuel in front of property modification with a property modification machine with oxidant gas with a burner, and to heat an antifreeze with the heat of reaction, It has a combustion waste gas supply means to supply the combustion waste gas discharged from an antifreeze heating means to the gas distribution channel of a property modification machine.

[0036] Therefore, by establishing an antifreeze heating means to heat an antifreeze with a burner, in the middle of the cooling course of an antifreeze in the polymer electrolyte fuel cell power generation system of invention of Claim 3, the heated hot antifreeze is supplied to the inside of fuel cell Stack, and a low-temperature fuel cell stack is heating **********. The simplification of a system and miniaturization can be simultaneously attained by supplying waste gas of the burner of an antifreeze heating means to the gas distribution channel inside a property modification machine, being able to preheat a property modification machine and being able to use the new burner for property modification machine preheating as unnecessary.

[0037] He is trying to supply as heating gas of an antifreeze heating means by invention of Claim 4 on the other hand in above-mentioned Claim 1 or the polymer electrolyte fuel cell power generation

system of invention of Claim 2 from a heating gas supply means to supply heating gas to a polymer electrolyte fuel cell stack.

[0038] Therefore, it sets to the polymer electrolyte fuel cell power generation system of invention of Claim 4. By using the heating gas of a polymer electrolyte fuel cell stack, and the heating gas supplied from the becoming heating gas supply means for the heating gas of the burner of an antifreeze heating means, a fueling system can be simplified and miniaturization of a system and low cost-ization can be attained.

[0039] Moreover, he is trying to supply as oxidant gas of an antifreeze heating means in invention of Claim 5 in above-mentioned Claim 1 or the polymer electrolyte fuel cell power generation system of invention of Claim 2 from an oxidant gas supply means to supply oxidant gas to a polymer electrolyte fuel cell stack.

[0040] Therefore, it sets to the polymer electrolyte fuel cell power generation system of invention of Claim 5. By using oxidant gas of a polymer electrolyte fuel cell stack, and the oxidant gas supplied from the becoming oxidant gas supply means for oxidant gas of the burner of an antifreeze heating means, an oxidant gas supply system can be simplified and the miniaturization of a system and low cost-ization are attained.

[0041] Furthermore, in invention of Claim 6, the heat exchanger which performs heat exchange of combustion waste gas from a catalyzed combustion machine and an antifreeze is added in the polymer electrolyte fuel cell power generation system of invention of above-mentioned Claim 1, using a catalyzed combustion machine as a burner of an antifreeze heating means.

[0042] Therefore, it sets to the polymer electrolyte fuel cell power generation system of invention of Claim 6. By using a catalyzed combustion machine for the burner of an antifreeze heating means, compared with the burner accompanied by the usual flame, cleaner combustion can be performed and poisoning by CO of a polymer electrolyte fuel cell stack can be lessened more. Furthermore, since a heat exchanger can be heated by the radiant heat from a catalyzed combustion machine by having the heat exchanger of combustion waste gas of a catalyzed combustion machine, and an antifreeze, it can be considered as a compacter heat exchanger.

[0043] On the other hand by invention of Claim 7, it sets to above-mentioned Claim 1 or the polymer electrolyte fuel cell power generation system of invention of any 1 clause of Claim 3. When the temperature of a temperature detection means to detect the temperature of a polymer electrolyte fuel cell stack, and the polymer electrolyte fuel cell stack detected by the temperature detection means at the time of a system startup is below the temperature set up beforehand, a control means to operate an antifreeze heating means is added.

[0044] Therefore, it sets to the polymer electrolyte fuel cell power generation system of invention of Claim 7. Since heating gas can be effectively used by equipping a polymer electrolyte fuel cell stack with a temperature detection means, and operating an antifreeze heating means when the temperature of a polymer electrolyte fuel cell stack is below the temperature set up beforehand, efficient preheating can be performed.

[0045] Moreover, in invention of Claim 8, it sets to above-mentioned Claim 1 or the polymer electrolyte fuel cell power generation system of invention of any 1 clause of Claim 3. When the temperature of the polymer electrolyte fuel cell stack detected by temperature detection means to detect the temperature of a polymer electrolyte fuel cell stack, and the temperature detection means

exceeds the temperature set up beforehand, a control means to stop an antifreeze heating means is added.

[0046] Therefore, it sets to the polymer electrolyte fuel cell power generation system of invention of Claim 8. By equipping a polymer electrolyte fuel cell stack with a temperature detection means, and stopping an antifreeze heating means, when the temperature of a polymer electrolyte fuel cell stack exceeds the temperature set up beforehand Since overheating of a polymer electrolyte fuel cell stack can be prevented while being able to use heating gas effectively, it can be considered as a more efficient and safe system.

[0047] Furthermore, in invention of Claim 9, it sets to above-mentioned Claim 1 or the polymer electrolyte fuel cell power generation system of invention of Claim 2. So that the temperature of the combustion waste gas detected by temperature detection means to detect the temperature of the combustion waste gas discharged from an antifreeze heating means, and the temperature detection means may not exceed a heat-resistant temperature of the component of a polymer electrolyte fuel cell stack A control means to control the combustion amount of an antifreeze heating means or the circulating load of an antifreeze is added.

[0048] Therefore, it sets to the polymer electrolyte fuel cell power generation system of invention of Claim 9. So that the temperature of combustion waste gas of an antifreeze heating means may not exceed a heat-resistant temperature of the component of a polymer electrolyte fuel cell stack By controlling the combustion amount of an antifreeze heating means, or the circulating load of an antifreeze, heating of a polymer electrolyte fuel cell stack can be prevented, and it can be considered as a safer and reliable system.

[0049] By invention of Claim 10, it sets further again to above-mentioned Claim 1 or the polymer electrolyte fuel cell power generation system of invention of Claim 2. A temperature detection means to detect the temperature of the combustion waste gas discharged from an antifreeze heating means, and a control means to control the combustion amount of an antifreeze heating means or the circulating load of an antifreeze so that the temperature of the combustion waste gas detected by the temperature detection means does not exceed a heat-resistant temperature of the component of a property modification machine are added.

[0050] Therefore, it sets to the polymer electrolyte fuel cell power generation system of invention of Claim 10. By controlling the combustion amount of an antifreeze heating means, or the circulating load of an antifreeze, heating of a polymer electrolyte fuel cell stack can be prevented, and it can be considered as a safer and reliable system so that the temperature of combustion waste gas of an antifreeze heating means may not exceed a heat-resistant temperature of the component of a property modification machine.

[0051]

[Mode for carrying out the invention] The form of operation of this invention is hereafter explained in detail with reference to Drawings.

[0052] (The form of the 1st operation: Correspond to Claim 1, Claim 4, and Claim 5) Drawing 1 is the mimetic diagram showing the example of system composition of the polymer electrolyte fuel cell power generation system by the form of this operation.

[0053] In drawing 1 , as shown in said drawing 8 , the polymer electrolyte fuel cell stack (a fuel cell stack is only called hereafter) 1 laminates two or more single cells 101 through the cold plate with

which the antifreeze which is a separator 105 and a cooling medium with a gas supply slot circulates, and is constituted.

[0054] The oxidant gas supply means 2 supplies the air which is oxidant gas to the fuel cell stack 1. As this oxidant gas supply means 2, a compressor and BUROWA are usually used.

[0055] The heating gas supply means 3 consists of regulators, stop valves, etc. for supplying a high-pressure cylinder, a liquid hydrogen tank, a hydrogen storage material container, and hydrogen by a proper pressure, when using hydrogen as direct heating gas.

[0056] Oxidant gas and heating gas let the oxidant gas supply course 5 and the heating gas supply course 6, the oxidant gas valve 7, and the heating gas valve 8 pass, respectively. After generating electricity by supplying the fuel cell stack 1, the gas supplied to the surplus is discharged outside through the oxidant gas discharge course 9 and the heating gas discharge course 10, respectively.

[0057] At the time of a system startup, the antifreeze heating means 11 introduces the antifreeze supplied from the antifreeze pump 12 through the antifreeze circulating course 14, burns heating gas with oxidant gas, and heats an antifreeze with the heat of reaction. After an antifreeze is heated with the antifreeze heating means 11, it is supplied to the fuel cell stack 1, and heats the fuel cell stack 1.

[0058] The antifreeze heating means 11 consists of a burner 20 and a heat exchanger 21 which performs heat exchange of combustion waste gas from a burner 20, and an antifreeze.

[0059] The antifreeze which came out of the fuel cell stack 1 returns to the antifreeze pump 12 through the antifreeze bypass line 15 and the antifreeze bypass valve 16, is again led to the antifreeze heating means 11, and is heated.

[0060] The antifreeze radiator 13 plays the role which misses the waste heat from the fuel cell stack 1 to the exterior, while the fuel cell stack 1 after a system startup is operated steadily. At this time, the antifreeze bypass valve 16 will be in the state where it closed.

[0061] Although it is the line used while heating using an antifreeze, a bypass line 15 is formed in order that this may avoid the heat dissipation from the radiator 13 at the time of heating.

[0062] The heating gas supply course 17 and the oxidant gas supply course 18 supply heating gas and oxidant gas to the antifreeze heating means 11, respectively.

[0063] It connects with the oxidant gas supply course 5 and the heating gas supply course 6, respectively, and the combustion waste gas supply course 19 supplies the combustion waste gas discharged from the antifreeze heating means 11 to the fuel cell stack 1.

[0064] Next, an operation of the polymer electrolyte fuel cell power generation system of the form of this operation constituted as mentioned above is explained.

[0065] In drawing 1 , oxidant gas and heating gas which were supplied to the antifreeze heating means 11 burn within a burner 20 at the time of a system startup. The hot combustion gas heats an antifreeze with the heat exchanger 21, and the antifreeze used as high temperature is led to the fuel cell stack 1 through the antifreeze circulating course 14, and heats the inside of the fuel cell stack 1.

[0066] Since the antifreeze is used as a cooling medium even if ambient air temperature is low temperature of 0 degree C or less at the time of a system startup at this time, there is no possibility that the antifreeze circulating course 14 may freeze, and the fuel cell stack 1 can be heated beforehand certainly.

[0067] [moreover, the combustion waste gas simultaneously discharged from the heat exchanger 21] The fuel cell stack 1 is supplied through the oxidant gas supply course 5 and the heating gas

supply course 6 to the fuel cell stack 1, and the solid polymer membrane 102 which is the main constituent factor of the fuel cell stack 1, the anode electrode 103, the cathode electrode 104, and separator 105 grade are heated directly.

[0068] When this steam condenses, moderate moisture is given to the solid polymer membrane 102 at the same time it heats the solid polymer membrane 102, since the steam accompanying a combustion reaction is contained in this combustion waste gas. Moreover, since the latent heat of vaporization is opened when a steam condenses, a lot of heat can be far told also by this flow rate rather than heating only with gaseous sensible heat.

[0069] In addition, you may make it supply this combustion waste gas to either the air supply course 5 or the heating gas supply course 6.

[0070] Furthermore, since the composition which shares the oxidant gas source of supply and heating gas source of supply of the antifreeze heating means 11 with the oxidant gas supply means 2 of the fuel cell stack 1 and the heating gas supply means 3 is taken in the form of this operation, It becomes unnecessary to newly have a source of supply for exclusive use, and a system can be simplified further.

[0071] As mentioned above, [the polymer electrolyte fuel cell power generation system of the form of this operation] Since the antifreeze is used as a cooling medium, it does not freeze, even if circumference environmental temperature becomes 0 degree C or less. In order that the antifreeze heated by an antifreeze heating means 11 to have a burner 20 may heat the fuel cell stack 1 through the antifreeze circulating course 14, the fuel cell stack 1 can be beforehand heated also in the time of low temperature, and it becomes possible to perform positive starting.

[0072] Since combustion waste gas of the antifreeze heating means 11 can be supplied to direct fuel cell stack 1 inside on the other hand, The solid polymer membrane 102 which is the main constituent factor of the fuel cell stack 1, the anode electrode 103 and the cathode electrode 104, and separator 105 grade can be heated directly, and it becomes possible to shorten the preheating time to a system startup sharply. Moreover, since moderate moisture can be supplied to the solid polymer membrane 102 with the steam contained in combustion waste gas of the antifreeze heating means 11, it becomes possible to give good conditions by operation after remaining heat.

[0073] That is, it becomes possible to aim at improvement in much more shortening of the starting time of the fuel cell stack 1, and the reliability of the solid polymer membrane 102, and improvement in endurance. Since the latent heat contained in a steam can be used effectively simultaneously, it leads also to miniaturization of a system, and improvement in energy efficiency.

[0074] Furthermore, since the oxidant gas source of supply and heating gas source of supply of the antifreeze heating means 11 are shared with this source of supply of the fuel cell stack 1, it becomes possible to attain the simplification of a system, low-cost-izing, and miniaturization.

[0075] (The form of the 2nd operation: Correspond to Claim 2) Drawing 2 is the mimetic diagram showing the example of system composition of the polymer electrolyte fuel cell power generation system by the form of this operation, it gives the same code to the same element as drawing 1 , omits the explanation, and describes only a portion different here.

[0076] In drawing 2 , the combustion waste gas distribution channel 22 is formed so that the circumference of the fuel cell stack 1 may be surrounded, it lets the combustion waste gas discharged from the antifreeze heating means 11 pass with the combustion waste gas supply course 23, and it is

led to the combustion waste gas distribution channel 22.

[0077] The combustion waste gas which heated the fuel cell stack 1 within the combustion waste gas distribution channel 22 is discharged from the combustion waste gas discharge course 24 outside.

[0078] Next, an operation of the polymer electrolyte fuel cell power generation system of the form of this operation constituted as mentioned above is explained.

[0079] In drawing 2 , oxidant gas and heating gas which were supplied to the antifreeze heating means 11 burn within a burner 20 at the time of a system startup. The hot combustion gas heats an antifreeze with the heat exchanger 21, and the antifreeze used as high temperature is led to the fuel cell stack 1 through the antifreeze circulating course 14, and heats the inside of the fuel cell stack 1.

[0080] Since the antifreeze is used as a cooling medium even if ambient air temperature is low temperature of 0 degree C or less at the time of a system startup at this time, there is no possibility that the antifreeze circulating course 14 may freeze, and the fuel cell stack 1 can be heated beforehand certainly.

[0081] Moreover, simultaneously, after passing along the combustion waste gas discharged from the heat exchanger 21 with the combustion waste gas supply course 23, leading it to the combustion waste gas distribution channel 22 and heating the fuel cell stack 1 from the outside within the combustion waste gas distribution channel 22, it is discharged from the combustion waste gas discharge course 24 in the system exterior.

[0082] That is, since the fuel cell stack 1 is heated from the outside by combustion waste gas at the same time it humidifies the fuel cell stack 1 from an inside with an antifreeze, the time which heat conduction takes becomes short and it can preheat in a short time.

[0083] Moreover, since combustion waste gas contains the steam and it can also use condensation latent heat effectively, it can carry a lot of heat also by this flow rate compared with the heat exchange by sensible heat.

[0084] In addition, the thing of the form of this operation which it is not limited to the composition of drawing 2 and mentioned above and you may make it combine with the form of the 1st operation is clear.

[0085] As mentioned above, [the polymer electrolyte fuel cell power generation system of the form of this operation] Since the antifreeze is used as a cooling medium, it does not freeze, even if circumference environmental temperature becomes 0 degree C or less. In order that the antifreeze heated by an antifreeze heating means 11 to have a burner 20 may heat the fuel cell stack 1 through the antifreeze circulating course 14, the fuel cell stack 1 can be beforehand heated also in the time of low temperature, and it becomes possible to perform positive starting.

[0086] On the other hand, in order to heat the fuel cell stack 1 from the outside by combustion waste gas at the same time it humidifies from an inside with an antifreeze, the time which heat conduction takes becomes short and becomes possible [shortening the preheating time to a system startup sharply]. Moreover, since combustion waste gas contains the steam and it can also use condensation latent heat effectively, it becomes possible [that a lot of heat can be carried also by this flow rate compared with the heat exchange by sensible heat].

[0087] That is, since the usually discarded condensation latent heat can be effectively used while preheating of the fuel cell stack 1 is attained further for a short time, consumption of efficient heating gas can be attained and the efficiency of a system can be raised.

[0088] (The form of the 3rd operation: Correspond to Claim 3) Drawing 3 is the mimetic diagram showing the example of system composition of the polymer electrolyte fuel cell power generation system by the form of this operation, it gives the same code to the same element as drawing 1 , omits the explanation, and describes only a portion different here.

[0089] In drawing 3 , the property modification machine 25 is changed into the heating gas which is made to carry out property modification of the first fuel of a hydrocarbon system, and makes hydrogen a principal component, and is supplied to said heating gas supply course 6.

[0090] The property modification dexterous moisture supply means 26 supplies moisture required for the property modification of the fuel for the property modification machine 25, and usually consists of a water tank and a pump.

[0091] The combustion waste gas discharged from the antifreeze heating means 11 is supplied to the property modification machine 25 through the combustion waste gas supply course 27, and heats the property modification machine 25 beforehand.

[0092] Next, an operation of the polymer electrolyte fuel cell power generation system of the form of this operation constituted as mentioned above is explained.

[0093] In drawing 3 , oxidant gas and heating gas which were supplied to the antifreeze heating means 11 burn within a burner 20 at the time of a system startup. The hot combustion gas heats an antifreeze with the heat exchanger 21, and the antifreeze used as high temperature is led to the fuel cell stack 1 through the antifreeze circulating course 14, and heats the inside of the fuel cell stack 1.

[0094] Since the antifreeze is used as a cooling medium even if ambient air temperature is low temperature of 0 degree C or less at the time of a system startup at this time, there is no possibility that the antifreeze circulating course 14 may freeze, and the fuel cell stack 1 can be heated beforehand certainly.

[0095] Moreover, simultaneously, after the combustion waste gas discharged from the heat exchanger 21 heats the property modification machine 25 first, it is supplied to the fuel cell stack 1, and it heats directly the solid polymer membrane 102 which is the main constituent factor of the fuel cell stack 1, the anode electrode 103, the cathode electrode 104, and separator 105 grade.

[0096] It is needless to say to make temperature of this combustion waste gas into sufficient temperature to heat the property modification machine 25 beforehand. Moreover, inside the fuel cell stack 1, since the steam accompanying a combustion reaction is contained in this combustion waste gas, when [which were mentioned above] this steam condenses like the form of the 1st operation at the same time it heats the solid polymer membrane 102, moderate moisture is given to the solid polymer membrane 102. Furthermore, since the latent heat of vaporization is opened when a steam condenses, a lot of heat can be far told also by this flow rate rather than heating only with gaseous sensible heat.

[0097] In addition, you may make it distribute this combustion waste gas to the oxidant gas supply course 5.

[0098] Moreover, the thing of the form of this operation which it is not limited to the composition of drawing 3 and mentioned above and you may make it combine with the form of the 2nd operation is clear.

[0099] As mentioned above, [the polymer electrolyte fuel cell power generation system of the form of this operation] Since the antifreeze is used as a cooling medium, it does not freeze, even if

circumference environmental temperature becomes 0 degree C or less. In order that the antifreeze heated by an antifreeze heating means 11 to have a burner 20 may heat the fuel cell stack 1 through the antifreeze circulating course 14, the fuel cell stack 1 can be beforehand heated also in the time of low temperature, and it becomes possible to perform positive starting.

[0100] After, preheating the property modification machine 25 on the other hand, in order to heat and humidify the inside of the fuel cell stack 1 by combustion waste gas, The solid polymer membrane 102 which is the main constituent factor of the fuel cell stack 1, the anode electrode 103, the cathode electrode 104, and separator 105 grade can be heated directly, and it becomes possible to shorten sharply the preheating time of the whole system to a system startup. Moreover, since moderate moisture can be supplied to the solid polymer membrane 102 with the steam contained in combustion waste gas, it becomes possible to give good conditions by operation after remaining heat.

[0101] That is, it becomes possible to aim at much more shortening of the starting time of the fuel cell stack 1, improvement in the reliability of the solid polymer membrane 102, and improvement in endurance. Since the latent heat contained in a steam can be used effectively simultaneously, it leads also to miniaturization of a system, and improvement in energy efficiency.

[0102] By the above, since the usually discarded condensation latent heat can be effectively used while preheating of the fuel cell stack 1 is attained further for a short time, consumption of efficient heating gas can be attained and the efficiency of a system can be raised.

[0103] (The form of the 4th operation: Correspond to Claim 6) Drawing 4 is the mimetic diagram showing the example of composition of the antifreeze heating means in the polymer electrolyte fuel cell power generation system by the form of this operation.

[0104] In drawing 4 , the antifreeze heating means 30 consists of a catalyzed combustion machine 31 and a heat exchanger 32 which performs heat exchange of combustion waste gas from this catalyzed combustion machine 31, and an antifreeze.

[0105] As a catalyzed combustion machine 31, that with which noble metals used as an active ingredient, such as platinum and Palladium, were supported is usually used for the honeycomb carrier made from ceramics made in cordierite etc.

[0106] Although the heat exchanger of a FINDO tube type which consists of an antifreeze pass 36 and a heat dissipation fin 37 is used as a heat exchanger 32, it is not limited to this at all and the heat exchanger of a shell and tube type may be used.

[0107] After the heating gas supply course 33 and the oxidant gas supply course 34 supply the air which is heating gas and oxidant gas, respectively and premixing is carried out at the premixing room 35, they are supplied to the catalyzed combustion machine 31, and burn.

[0108] After combustion waste gas from the catalyzed combustion machine 31 heats an antifreeze with the heat exchanger 32, it is discharged from the combustion waste gas outlet 38.

[0109] In addition, it cannot be overemphasized that a fuel evaporator or an atomization machine is required, of course in the case of a liquid fuel.

[0110] Next, an operation of the antifreeze heating means 30 in the polymer electrolyte fuel cell power generation system of the form of this operation constituted as mentioned above is explained.

[0111] In drawing 4 , it mixes with oxidant gas, and heating gas is sent to the catalyzed combustion machine 31, and performs catalyzed combustion. Compared with the usual flame combustion, this catalyzed combustion can control generation of harmful emission gas, such as NOx and CO, further,

and can perform clean combustion.

[0112] Although especially CO may carry out poisoning of the platinum catalyst used for the anode or cathode catalyst of the fuel cell stack 1, when this catalyzed combustion machine 31 is used, that fear does not exist.

[0113] Moreover, since the catalyst itself is heated by high temperature, the catalyzed combustion machine 31 can expect heat transfer to which many radiant heat from a catalyst occurred and added radiant heat in the heat exchanger 32 of a FINDO tube type compared with heat transfer by the convection of only combustion gas, and can obtain a still higher heat transfer rate.

[0114] [the antifreeze heating means 30 in the polymer electrolyte fuel cell power generation system of the form of this operation] as mentioned above Since the catalyzed combustion machine 31 is used for the burner, even if it becomes possible to make combustion waste gas still cleaner and supplies this combustion waste gas to the inside of the fuel cell stack 1 Since the bad influence to the cell catalyst of CO can be stopped to the minimum, it becomes possible to consider it as a much more reliable polymer electrolyte fuel cell power generation system.

[0115] Furthermore, since he is trying to use the radiant heat from a catalyst and a higher heat transfer rate can be obtained from combustion waste gas of the catalyzed combustion machine 31 to the heat exchanger 32, a heat transfer area can be made small and it becomes possible to realize a still compacter system.

[0116] (The form of the 5th operation: Correspond to Claim 7 or Claim 10) Drawing 5 is the mimetic diagram showing the example of system composition of the polymer electrolyte fuel cell power generation system by the form of this operation, it gives the same code to the same element as drawing 1 , omits the explanation, and describes only a portion different here.

[0117] namely, [the polymer electrolyte fuel cell power generation system of the form of this operation] As shown in drawing 5 , the oxidant gas supply means 2 in said drawing 1 , the heating gas supply means 3, the oxidant gas valve 7, the heating gas valve 8, the antifreeze pump 12, and the antifreeze bypass valve 16 are omitted. Replace with these, form the oxidant gas supply means 54, the heating gas supply means 55, the antifreeze pump 56, the oxidant gas valve 57, the heating gas valve 58, and the antifreeze bypass valve 59, and further The control unit 51, It has composition which added the fuel cell stack temperature detection means 52 and the combustion waste gas temperature detection means 53.

[0118] In addition, since the composition of a control system system is almost common, and a composition top is also the same [composition] except that combustion waste gas is used for preheating of the property modification machine 25 when [which uses the property modification machine 25 which mentioned the form of this operation above] applying to the form of the 3rd operation, illustration of the system system is omitted here.

[0119] The fuel cell stack temperature detection means 52 is formed in said fuel cell stack 1, and detects the temperature.

[0120] The combustion waste gas temperature detection means 53 detects the temperature of the combustion waste gas discharged from said antifreeze heating means 11.

[0121] The temperature of the fuel cell stack 1 from which the control unit 51 was detected by the fuel cell stack temperature detection means 52, Temperature of the combustion waste gas detected by the combustion waste gas temperature detection means 53 is considered as an input. The

operational status of a system is grasped based on such temperature, and the oxidant gas supply means 54, the heating gas supply means 55, the antifreeze pump 56, the oxidant gas valve 57, the heating gas valve 58, and the antifreeze bypass valve 59 which are an instrument used as a controlled object are controlled.

[0122] When [namely,] the temperature of the fuel cell stack 1 detected by the fuel cell stack temperature detection means 52 at the time of a system startup of the control unit 51 is below a predetermined temperature set up beforehand When the temperature of the fuel cell stack 1 which the antifreeze heating means 11 was operated and was detected by the fuel cell stack temperature detection means 52 exceeds a predetermined temperature set up beforehand, the instrument used as the above-mentioned controlled object is controlled to stop the antifreeze heating means 11.

[0123] Moreover, as the control unit 51 controls the combustion amount of the antifreeze heating means 11, or the circulating load of an antifreeze, it controls the instrument used as the above-mentioned controlled object, so that the temperature of the combustion waste gas detected by the combustion waste gas temperature detection means 53 does not exceed a heat-resistant temperature of the component of the fuel cell stack 1.

[0124] Furthermore, [the control unit 51] when [which uses the property modification machine 25] applying to the form of the 3rd operation, so that the temperature of the combustion waste gas detected by the combustion waste gas temperature detection means 53 may not exceed a heat-resistant temperature of the component of a property modification machine The instrument used as the above-mentioned controlled object is controlled to control the combustion amount of the antifreeze heating means 11, or the circulating load of an antifreeze.

[0125] Next, an operation of the polymer electrolyte fuel cell power generation system of the form of this operation constituted as mentioned above is explained using drawing 6 and drawing 7 .

[0126] Drawing 6 is the figure showing the control flow chart of the system shown in drawing 5 , and drawing 7 is the figure showing the control flow chart in the case of the system which has the property modification machine 25.

[0127] In drawing 5 , when a system is started, in the case of not more than [which was set up beforehand / predetermined] temperature T1, the temperature of the fuel cell stack 1 detected by the fuel cell stack temperature detection means 52 shifts to the control mode which heats the fuel cell stack 1 beforehand.

[0128] Usually, as this predetermined temperature T1, the value near a temperature of the fuel cell stack 1 of operation is set up. That is, in a polymer electrolyte fuel cell power generation system, the value of about 70 to 80 degrees C is set up, for example.

[0129] Since the temperature of the fuel cell stack 1 does not need to become hot beforehand highly [when a starting directive is issued immediately after a stop] enough when higher than the predetermined temperature T1, it shifts to modes of power generation immediately.

[0130] moreover, when the temperature of the fuel cell stack 1 is less than temperature T1 predetermined While changing into the state where an antifreeze can be poured to the bypass side, by making the antifreeze bypass valve 59 into **, the oxidant gas valve 57 and the heating gas valve 58 are closed-**(ed), and it changes into the state where oxidant gas and heating gas can be supplied to the antifreeze heating means 11.

[0131] Then, the burner 20 of the antifreeze pump 56 and also the antifreeze heating means 11 is

operated to the oxidant gas supply means 54, the heating gas supply means 55, and a pan.
[0132] Next, an antifreeze is heated adjusting the combustion amount of the antifreeze heating means 11, and the circulating load of an antifreeze, and it becomes the mode which heats the fuel cell stack 1 beforehand, and preheating mode continues until the temperature of the fuel cell stack 1 exceeds the predetermined temperature T2 set up beforehand.
[0133] Usually, the value near a temperature of the fuel cell stack 1 of operation is adopted like the above-mentioned predetermined temperature T1 as this predetermined temperature T2. That is, while the state in preheating mode continues, the temperature Tg of combustion waste gas is always supervised with the combustion waste gas temperature detection means 53.
[0134] If the temperature Tg of combustion waste gas becomes higher than the heat-resistant temperature T3 of the component of the fuel cell stack 1 set up beforehand, conditions of operation will be changed immediately, and it will control so that the temperature Tg of combustion waste gas turns into a temperature lower than the heat-resistant temperature T3.
[0135] Usually, this heat-resistant temperature has the lowest solid polymer membrane 102 in the element parts of the fuel cell stack 1, for example, is set as 120 degrees C or less.
[0136] If the temperature of the fuel cell stack 1 exceeds the predetermined temperature T2, after completing preheating and suspending the burner 20 of the antifreeze heating means 11, the oxidant gas valve 57 and the heating gas valve 58 will be changed into the mode at the time of power generation, and power generation will be started.
[0137] On the other hand, in the case of the system which heats the property modification machine 25 beforehand, the temperature of this combustion waste gas is set up highly, and a heat-resistant temperature of the component of the property modification machine 25 is also highly set to it.
[0138] However, a heat-resistant temperature about the fuel cell stack 1 etc. is the same, and a control flow becomes being almost the same as that of drawing 6 , as shown in drawing 7 .
[0139] As mentioned above, [the polymer electrolyte fuel cell power generation system of the form of this operation] When the temperature of the fuel cell stack 1 is below the temperature set up beforehand, in order to try to operate the antifreeze heating means 11, heating gas can be used effectively and it becomes possible to perform much more efficient preheating.
[0140] Moreover, since he is trying to stop the antifreeze heating means 11 when the temperature of the fuel cell stack 1 exceeds the temperature set up beforehand, while being able to use heating gas effectively Overheating of the fuel cell stack 1 can be prevented and it becomes possible to consider it as a much more efficient and safe system.
[0141] Furthermore, since the combustion amount of the antifreeze heating means 11 or the circulating load of an antifreeze is controlled so that the temperature of combustion waste gas of the antifreeze heating means 11 does not exceed a heat-resistant temperature of the component of the fuel cell stack 1, Heating of the fuel cell stack 1 is prevented and it becomes possible to consider it as a much more safe and reliable system.
[0142] [the property modification machine 25 / in the case of the system heated beforehand] further again Since the combustion amount of the antifreeze heating means 11 or the circulating load of an antifreeze is controlled so that the temperature of combustion waste gas of the antifreeze heating means 11 does not exceed a heat-resistant temperature of the component of the property modification machine 25, heating of the fuel cell stack 1 is prevented and it becomes possible to

consider it as a much more safe and reliable system.

[0143] Since he is trying to control appropriately each controlled object instrument (the oxidant gas supply means 54, the heating gas supply means 55, the antifreeze pump 56, the oxidant gas valve 57, the heating gas valve 58, antifreeze bypass valve 59) by the above, Since heating gas can be effectively used while being able to consider it as a safe and reliable system without danger, such as overheating, it can be considered as a system with still higher energy efficiency.

[0144]

[Effect of the Invention] Since he is trying to use an antifreeze as a cooling medium of a fuel cell stack according to the polymer electrolyte fuel cell power generation system of this invention as explained above In order that the antifreeze heated by an antifreeze heating means not to freeze even if circumference environmental temperature becomes 0 degree C or less, and to have a burner may heat a fuel cell stack through an antifreeze circulating course, a fuel cell stack can be beforehand heated also in the time of low temperature, and it becomes possible to ensure starting.

[0145] Moreover, since a fuel cell stack is heated and he is trying to heat a property modification machine, using combustion waste gas of an antifreeze heating means effectively Since he is trying to use the steam contained in combustion waste gas while attaining much more shortening of the starting time of a fuel cell stack, it becomes possible to aim at improvement in the reliability of a solid polymer membrane, and improvement in endurance.

[0146] Furthermore, since the latent heat contained in a steam can be used effectively, it becomes possible to aim at miniaturization of a system, and improvement in energy efficiency.

[0147] By the above, even if circumference environmental temperature becomes low temperature of 0 degree C or less, it can start with structure safely efficient in a short time, and compact moreover.

[Translation done.]